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| Mr. Michael T. Davis  WLPCS Pre-Calculus | 2.9 How to Find VA, HA, Intercepts & Asymptotes  February 14-15, 2018 |

**Vertical Asymptotes (VA) or Infinite Discontinuities**

A VA exists for each value of x that makes the denominator 0 but the numerator not zero, which is an undefined value. For example, the graph of  has a vertical asymptote with equation  because a 2 substituted into the x variables makes the denominator 0 and the numerator 3, i.e. .

**Horizontal Asymptotes (HA) or Infinite Discontinuities**

**Case 1:** If the denominator has a LESSER degree than the numerator, then the graph does not have a HA. For example,  has a denominator of degree 1 and a numerator of degree 2, therefore the graph of  does not have a HA.

**Case 2:** If the degree of the denominator is GREATER than the degree of the numerator, then the HA is always the x-axis with equation . For example, the graph of  has a HA of .

**Case 3:** If the degree of the denominator is EQUAL to the degree of the numerator, then the HA is found by dividing the coefficient of the greatest powered x in the numerator by the coefficient of the same powered x in the denominator. For example, the graph of  has a HA of  or .

**Holes or Removable Discontinuities**

If the numerator and denominator share the same factor with the same power, then the graph has a hole or missing point at the value of x that causes both the denominator and numerator to be zero. For example, the graph of  has a hole at .

**Y-Intercept**

The y-value of the y-intercept is found by substituting a 0 into all the x variables in the rational expression. For example, the rational function  has a y-intercept of  because . A rational function graph can have only one y-intercept.

**X-Intercepts**

The x-value of an x-intercept exists when the rational expression is equal to 0, which is when the numerator is equal to 0 but the denominator is not 0. For example, the numerator of the rational function  is  and  at  and at . Note that  and  because there is a hole at  because 

So, the one x-intercept is the point  and there is no x-intercept at .